ON05795

WORKING PAPERS OF THE OFFICE OF DEVELOPMENT RESEARCH

85-3

Educational Videodiscs: Current Research and Development

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May 1985

92-06385/

TVOntario

Office of Development Research
Bureau de recherche pour le développement

Working Paper 85-3

EDUCATIONAL VIDEODISCS:

CURRENT RESEARCH AND DEVELOPMENT

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INTRODUCTION

Efforts to improve the effectiveness of education and training have produced many innovative applications of communications and information technologies. Visual aids have always been thought to enhance learning, and teachers often use slides, films and television to illustrate and supplement their classroom presentations. With the advent of the "new" technologies, learning opportunities have ideally been made more accessible and more flexible.

One of the most striking developments is that students of all levels at many educational institutions in Canada are currently using microcomputers for skills acquisition and data processing in several subject areas. Microcomputers are seen by some as efficient teaching and learning devices. They provide self-paced instruction and drill and practice of certain skills, freeing teachers to direct learners and teach concepts requiring more in-depth explanation, discussion and analysis. Some teachers are reluctant to implement computer technology for many reasons, including fear of being replaced by a computer, disdain for the impersonal qualities of human-machine interaction, and dissatisfaction with the quality of software. As it is introduced into education, videodisc technology may become subject to this same enthusiasm, and these same reservations.

Interactive videodiscs incorporate high quality sound and motion or still visuals with the capacity for interactive computer technology to allow for individualized pacing and branching through the course of a lesson. Videodiscs offer rapid random access of up to 54,000 frames, indefinite freeze-frame capacity, and frame-by-frame (step-motion) viewing capabilities. Computer interfacing provides greatly expanded storage capacity for text and graphics, review and test questions, and program structuring.

These features enhance the appeal of videodiscs for those educators who must serve a large group of geographically or academically disparate learners, or in disciplines where concepts such as motion and development figure prominently, or when class presentations would be enhanced by easily accessible, high-quality color visuals.

The cost of videodisc equipment and the overall lack of quality educational software have so far tempered any potential enthusiasm for videodiscs in Canadian schools. However, declining costs and the recordable and erasable disc will make the technology more accessible to schools. A smaller, less expensive eight-inch disc is now available with a storage capacity of 25,200 frames. But before teachers and administrators will welcome videodiscs into the classroom, the effectiveness of the videodisc as a complex learning tool must be improved. Because they incorporate all of the features of computer-assisted learning with those of sophisticated film, video, and still images, videodiscs introduce a wide range of variables to the learning process. Investigations into the role of videodiscs in learning could build on the knowledge and experience derived from past research on the effectiveness and implications of other educational media. The evaluative criteria for educational videodiscs should consider the interaction of all relevant variables with one another, and with learners of different abilities and in different learning contexts.

Most of the research described in this paper uses criteria that measure the capacities of videodiscs to improve lesson presentation and administration, and to meet a larger range of learners' needs than might be possible in traditional classrooms. These are evaluations of the technology itself. More far-reaching investigation into the many factors involved in the process of learning with all the media that are combined in videodiscs is necessary to improve the videodisc as a learning tool.

This paper describes current trends of videodisc use in education with selected examples of particular applications and descriptions of the research done to evaluate them. The aim of this report is to assess the present status of research and development of educational videodiscs so that future research and development directions can be determined. The information reported here supplements that presented in the prior Office of Development Research report, "Educational Videodisc in Canada," Paper 13 of the UNESCO series New Technologies in Canadian Education.

The first section of the paper deals with videodisc use in industrial and military training. This area of application is distinct from traditional education in that the goal of training is to teach very specific skills as quickly as possible. In the sections that follow, videodisc applications in education in Canada, the United States and

Great Britain are discussed. These are mainly trial applications in which videodiscs were tested for their effectiveness in specific courses. The next section of the paper describes videodiscs developed for health and medical education, and public information purposes. The final section presents a discussion of the issues and concerns surrounding the integration of videodiscs into the learning process and offers suggestions as to the ways TVOntario might participate in the research, development, and utilization of educational videodiscs.

VIDEODISCS IN MILITARY AND INDUSTRIAL TRAINING

Most videodisc research and development has been based on military and industrial applications. In both areas the scale of training programs merits the large capital investment required for the development of videodiscs and the acquisition of the necessary hardware. These costs are easily recouped from the savings in travel expenses, equipment deterioration, extended time off, and classroom training. Videodisc training is decentralized and flexible, and is based on simulations rather than hands-on experience.

Traditionally, industrial training has been delivered in specially-equipped training centres where lectures are supplemented by books, filmstrips, videotapes and lab exercises. In some cases, these methods have been seen as inadequate by industry because of their costs, the adverse effects they have on worker productivity, the lack of motivating material, and the limited opportunities available to learners for review. Some industrial trainers have thus looked to interactive videodiscs to provide self-paced, stimulating lessons that are easily accessible to employees and cost-effective to employers.

Digital Equipment Corporation has developed and made available the Interactive Video Information System (IVIS), a laser optical reflective videodisc player interfaced with a computer. They use the system themselves to provide "effective and stimulating training" in the operation, installation, and repair of three of the company's products. Digital's Educational Services Department conducted evaluation studies to determine how IVIS courses compared to the traditional training method. The short-term results of the studies indicated that the average time students needed to complete the IVIS courses was 23% to 46% less than the time students needed to complete the traditional training course. No significant differences were found in the students' ability to complete tasks related to the material presented in the training lessons.

A student opinion form was administered online following the course to obtain feedback for Field Service engineers on whether they accepted IVIS as a training delivery system and whether they thought IVIS courses were stimulating and motivating. The questionnaire consisted of 22 Likert

statements to measure student opinions about the course design and content, course delivery and media, course facility and administration, and the IVIS training experience in general. Other than problems with hardware and software operation, the student responses were very favorable. Most students found the IVIS to be a fun, interesting, and motivating experience. Some felt that the lack of hands-on training was a drawback to the system.

As a result of these findings, software checks have been built into the IVIS course development process, and future IVIS courses will include optional lab exercises. By 1987, 75% of all Field Service training at Digital Equipment Corporation will be offered through IVIS. The expected benefits include improved quality of training, increased standardization of training, convenience of retraining and review training, and significantly reduced training costs.

In July 1983, Xerox Learning Systems introduced Professional Selling Skills System III, an interactive videodisc package designed for use by sales trainees in a group setting. Although the concepts behind the program are standardized, the interactive videodisc enables each use of the course to be a unique process and allows for different levels of applications: for first-time students or those who need review, for new employees or experienced sales professionals. Four years in the making, the system presents a "perfect" remedy for many of the pitfalls of training programs: it encourages attentiveness and increases motivation with the use of animation, music, and a game-show-style review section with canned applause and other show-biz techniques. "This and other techniques are not those ordinarily employed in the production of a training course, but the new medium calls for a fresh and imaginative approach when producing corporate-type materials."[1]

Honeywell has produced a voice-interactive videodisc to provide on-the-job training for technicians responsible for maintaining gas turbine engines on ships of the Canadian Navy. The technician interacts via a helmet-mounted video screen with a multimedia database that includes both still and motion imagery with graphics and text overlays. Earphones in the helmet provide for receipt of audio information and a microphone allows the technician to converse with the system using single word commands, thus allowing the technician to operate in confined spaces with his/her hands free. The helmet is connected to a beltpac that contains the television receiver, power supply, and

reception equipment. The helmet and beltpac can be linked to the auxiliary equipment (the computer, videodisc player, and transmission equipment) via coaxial cable or radio frequency link. Honeywell has developed an authoring system called Courseware Lesson Authoring Subsystem (CLASS) to facilitate the creation of a computer program to manipulate the videodisc pictures, audio, graphics, and text overlays as the instructor/designer requires.

The U.S. Army Continuing Education System has sponsored the development of a videodisc to teach functional literacy to American soldiers stationed at remote sites where traditional educational programs are not available. The Space/Time Reconnaissance System (STARS) takes soldiers on a journey through time to exciting environments where they must apply functional literacy skills to accomplish their missions. Student performance is assessed through the gaming environment. As student deficiencies are encountered, the student is immediately presented with instruction matched to the required functional literacy skills. This is seen as an ideal use of the medium because it saves soldiers from a potentially embarrassing classroom setting where their illiteracy would be exposed to their peers. (The game-playing, the fantasy, and the lack of social contact form an interesting contrast to the politicizing literacy programs developed for Brazilian peasants by Paulo Freire.)[2]

The videodisc applications described above have been evaluated in terms of how well they increase the efficiency of industrial training programs: the speed with which material can be learned, the length of time trainees' attention can be held, and the flexibility and accessibility of the hardware itself. Education may be considered a more holistic, long-term process than industrial or sales training, and therefore variables other than recall efficiency and cost-effectiveness must be taken into consideration when evaluating the effectiveness of a technology. None of the above evaluations consider the experience of learning and how that experience changes with the use of videodisc technology. The effect of using the videodisc technology for the first time has been noted as an important motivator in many of the research studies. However, longitudinal study results are not yet available on students' reactions to the tenth use of interactive video material, nor on their long-term retention of information learned by videodisc manipulation, nor on their attitudes toward classroom learning or learning with other media after using videodiscs. These questions have rarely been asked,

indicating perhaps, a focus of attention on the immediate retention of information rather than on the process of learning.

The following sections deal with videodisc trial applications in other educational settings, where other qualities of the learning experience hopefully play more significant roles in the development of technologies for education.

VIDEODISC APPLICATIONS IN EDUCATION IN CANADA

Development of educational videodiscs in Canada is still sparse. The technology is perceived by some educators and media specialists at Concordia University, the National Film Board, ACCESS Alberta, the Ontario Institute for Studies in Education, and the Ontario Ministry of Education to have tremendous potential for educational purposes. A number of pilot projects have been undertaken to produce and test interactive, curriculum-based videodiscs for use in classrooms and learning centres. The majority of these developments have occurred in Alberta and Ontario, and the most recent projects will be described in this section.

In September 1984, the Alberta Laserdisc Committee submitted a report to the Alberta legislature recommending that the government support the development and expansion of the potentially lucrative videodisc industry in Alberta. (A copy of this report is available in ODR.) This Committee sponsors conferences for researchers and developers of videodisc hardware and software, and maintains the Laser Loan Library, a collection of videodiscs donated by vendors and publishers and available for loan to individuals and institutions in Alberta. The Committee has also developed criteria for evaluating videodisc vendors, hardware, and software (copy available in ODR).

ACCESS Alberta has created and is currently evaluating an interactive videodisc for the Alberta Vocational Centre. Titled English for Life and Work, the disc is designed to teach English as a second language to Canadian immigrants. Videodisc was considered the ideal medium for this purpose because it allows viewers to control the learning sequence and pace.

The learning package consists of two videodiscs--one linear and one interactive, a student workbook and audiotape for outside practice, an instructor's guide designed either for a classroom or learning centre setting, and a computer program for spelling and dictation testing. A resource book is also provided for instructors who wish to revise the computer program. The interactive disc contains a visual drama of a young man who must work his way through a bureaucratic maze in order to enroll in educational courses. At several points in the story, the viewer is asked to decide what the young man should do next. The story proceeds according to the path

the viewer has chosen, and at the end, spelling and dictation tests are administered via the microcomputer/videodisc interface.

The cost for developing and evaluating the disc are estimated to be about $140,000, including ACCESS staff time, daily studio rental, union wages for actors, producer, director, editors, and camera operators, and disc pressing and duplication by Sony, Inc.[3]

The field testing and evaluation of the videodisc will attempt to compare interactive and noninteractive use of the disc. Telephone interviews with students have been designed to elicit their attitudes toward the disc itself, its format, and content. Written tests will also be administered to determine students' acquisition of vocabulary and their understanding of cultural behaviors acted out in the story. The learning package is being distributed to selected educators and trainers in the U.S., U.K., and Australia in order to obtain their opinions of its educational value.

ACCESS is also working with the Calgary School Board to develop an interactive videodisc containing 25,000 slides of Alberta flora and fauna to enhance the science curriculum in Alberta schools. The disc is expected to be completed by the end of 1985. The Alberta Department of Education is in the process of producing a videodisc comprising 25,000 slides of artwork from around the world to support the art curriculum in Alberta schools. The rationale behind the transfer of slides to videodisc is that videodisc technology is considered more portable, durable, and flexible than slides and slide projectors.

At the University of Alberta, the Faculty of Education has developed a two-sided interactive videodisc to teach teachers-in-training how to maintain classroom discipline. The disc is available for $325. The Faculty of Physical Education at the University is currently developing up to three videodiscs to train Canadian Olympic teams. It is felt that the freeze-frame, slow motion, and random access capabilities of the technology render it highly appropriate for this type of application. The first disc will be for the Canadian Olympic Volleyball team.

The Northern Alberta Institute of Technology (NAIT) has recently purchased two videodiscs for U.S.$500 from the University of Washington in Seattle for use in studying hematology and cytology. Each disc contains slides of blood

smears obtained from the American Hematological Association, and is used as a visual database to supplement classroom lectures and administer student assignments and exams. For the latter, students view the slides and log their responses and diagnoses onto a computer.

NAIT has one Sony videodisc player interfaced with an Apple IIe, and a 100" Sony projection screen is used to enhance lectures. To complete assignments and exams, students must take turns using the disc player. Student opinions of the videodiscs are favorable. However, not until additional hardware is acquired will substantive evaluations be possible. NAIT plans to purchase additional discs in June 1985 for use in paracytology, bacteriology, histology, and geology courses, as well as Space Disc #6, a disc on meteorology produced from a National Aeronautics and Space Administration (NASA) database.

Reseachers at the Ontario Institute for Studies in Education (OISE) have been developing educational videodiscs since 1981. Two of their discs, Economic Geography and Canada's Magical Museum, are currently being revised for pilot-testing in two junior high schools next fall. Work is nearing completion on a new disc on fitness, diet, health, and safety, titled Feeling Fit, which will be on public display at Ontario Place this summer (1985), and will undergo evaluation next year. Direct costs for the development of Feeling Fit have been estimated at $25,000 for the partial salary of one professor, several students' labor, and a freelance scriptwriter; and $6,000 for materials and mastering, not including video production equipment. These costs are comparatively low because they do not include delivery to testing sites of videodisc workstations that cost $8,000 each, nor do they take into account the cost of the video and editing equipment that comprises the $500,000 television studio at OISE.

An OISE research seminar on interactive video and graphics is investigating the motivational properties of interactive video, examining such questions as the optimal level of visual complexity, the effect of print pre-tests on interactivity, and the readability of text on a CRT compared to that of hard copy. The answers to these types of questions will hopefully guide future videodisc production by allowing educators and instructional designers to better understand the nature of interaction between the learner and the videodisc on a number of different levels, incorporating a number of different media variables. (A study of the

theory of instructional design for interactive video is available from the ERIC Clearinghouse under the subject heading "Adult Vocational Education.")

The seven-member colleges of Ontario's Gold Coin Project (Canadore, Conestoga, Lambton, Niagara, St. Lawrence, Sault, and Sir Sandford Fleming) collaborated on the production of two interactive videodiscs during February-March 1985. The aim of the project, funded by the federal government's Skills Growth Fund, was to gain experience in videodisc production from professional developers that would allow Gold Coin members to produce videodiscs independently in the future. The project resulted in the development of two videodiscs for occupational training: one on systems analysis, electronics, and metal fabrication, and the other on industrial maintenance mechanics. Each disc is a blend of video, slides, and computer-generated text and graphics, and will be used to supplement classroom lessons.

Subject matter experts from each of the member-colleges wrote the scripts and branching programs for the discs. Interactive Image Technologies of Toronto and Linda Martin were hired as the creative consultants/producers for the project. The consultants' fee, ($13,000 for both), included production, mastering, and duplication costs.

The Independent Learning Centre of the Ontario Ministry of Education is also talking with Interactive Image Technologies about the development of a videodisc to teach basic English to adults enrolled in their distance education program. The disc will contain a series of 10 lessons and will be accompanied by computer-generated review questions and print materials. The disc is expected to be completed by 1987, and will be available only to schools and learning centres that have independently acquired the appropriate equipment.

The Computers in Education division of the Ontario Ministry of Education is investigating the possibility of creating an interactive videodisc database of film, slide, and video material in a variety of subjects that could serve as a valuable resource for teachers and students. Coordinators are currently negotiating the development and acquisition of materials from TVOntario and the National Film Board.

The audiovisual department at Concordia University in Montreal is collaborating with Bell Canada and Sony, Inc. to develop an interactive videodisc learning package to train Concordia staff in the operations of Centrex 3, Bell's new

telephone technology. The new telephone system can perform many more functions than traditional telephones, and employees not familiar with its operations cannot take advantage of the system's potential.

Four disc sides produced by Concordia offer users a simulated telephone environment where they interact via telephone and television monitor with "callers" in different situations and learn how to implement the various functions of Centrex 3. The interactive process is transparent, that is, users have the impression that the interaction is real and "natural," and that the system was created for them personally. The telephone acts as a voice-sensitive keyboard input to a hidden computer that controls the videodisc and telephone, as well as the display of videotex graphics.

The system will be tested throughout Concordia next summer (1985) using 10 workstations. The objectives of the test are to determine whether the new training system is more interesting, more standardized, faster, and more cost-effective than the traditional training method used by Bell.

EDUCATIONAL VIDEODISCS IN THE UNITED STATES

The development of educational videodiscs in the United States is more extensive than in Canada. Government agencies and private industry have sponsored the research and development of videodiscs for educational and informational purposes in several areas. As mentioned above, current applications in training far outnumber those in education. However, the level of investment of resources, expertise, and finances indicates a high level of interest in videodisc's educational potential.

The International University Consortium for Telecommunications (IUC) is a network of colleges and universities in partnership with public broadcasting stations and cable systems. Through its members, IUC offers adult part-time students the opportunity to earn a bachelor's degree without attending on-campus classes. The television components of its 20 distance education courses are normally delivered via satellite from the Maryland Center for Public Broadcasting (MCPB) to public broadcasting stations which record the programs onto tape. The broadcasters erase and reuse the tapes each semester, forcing the MCPB to repeat courses in its satellite schedule. As well, MCPB sends videotapes of the programs to cable broadcasters who are unable to record off the satellite feed.

In a 1983 feasibility study, the IUC collaborated with Pioneer Video to determine whether videodisc technology would provide a more cost-effective mode of delivery for IUC programming. Eight one-half hour programs for the course "Exploring Language: Thinking, Writing, Communicating" were transferred onto a videodisc programmed with chapter stops and discussion questions. The discs were distributed along with videodisc players and operating instructions to participating universities, colleges, hospitals, libraries, and learning centres across the country.

At the University of South Alabama, the availability of the videodisc provided opportunities for viewing and reviewing video material to those students who did not otherwise have access to the local cable system. The disc was used to supplement print materials and classroom sessions. Students and instructors alike found the videodiscs to be accessible, flexible, easy-to-operate, and of high-quality.

The Maryland Center for Public Broadcasting used the "Exploring Language" disc as the point of origin for local broadcasts. The videodisc machine was found to be compact and easy to operate, and the audio and video signals were of good quality. The disadvantages were that the content of the disc is fixed and permanent, strong vibration or bumping can cause the laser beam to skip, and programming length is limited to 30 minutes per side.

Pennsylvania State University used the disc in English, anthropology and journalism courses. The disc was also used to originate programming at the University's statewide educational cable network. The signal quality was found to be excellent, and cueing the disc was easy and accurate.

Some participants in this study voiced concern as to the high cost of videodisc hardware when they already had access to videocassette players. However, given that 200 copies of each of 20 courses would be necessary to accommodate all IUC members, project coordinators concluded that savings in tape duplication and satellite time would balance out the cost of equipment acquisition.

Representatives of seven public broadcasting organizations formed the Interactive Videodisc Consortium in August 1984. The purpose of the Consortium is to research and develop educational videodiscs, promote the development of national hardware and software standards for education and public broadcasting, and promote the sharing and exchange of information and resources among public broadcasters. (Information from this Consortium is received regularly in ODR.)

The Bank Street College of Education Research Centre in New York City is conducting a three-month evaluation of videodisc use in grades six through nine classrooms. The Voyage of the Mimi, a science and math television program produced by Bank Street and aired over the Public Broadcasting System, is being transferred onto an experimental videodisc and placed in classrooms currently using The Voyage of the Mimi materials. Researchers will observe how students interact with the disc, and will try to determine the difficulties and opportunities posed by the disc, as well as the extent and type of training teachers need to effectively implement videodiscs. A more elaborate disc to teach reading skills is planned once results from this evaluation are synthesized.

Two recent doctoral dissertations at the University of Nebraska, one by Mary Jane Wankel and the other by Scott Michael Stevens, compared differences in students' acquisition of specific physics concepts between those conducting hands-on laboratory experiments and those conducting surrogate experiments on The Puzzle of the Tacoma Narrows Bridge Collapse videodisc. The results of these studies showed that students in both groups scored similarly on physics content tests administered after the lab experiments. However, subsequent data analysis in Stevens' study revealed that students using the videodisc to conduct their experiment separated and controlled variables in significantly different ways than the control group, which used actual laboratory equipment. Students in the experimental group selected variables in terms of their symbmetric patterns on the video monitor rather than separating and controlling one variable at a time, as the control group did. Stevens concluded that students using the videodisc treated the spatial arrangements of words on the screen as the variables, rather than isolating and controlling the variables, e.g., tension or length, represented by the words. The thesis recommends that reminders be built into the computer program to prevent students from grouping variables incorrectly. Stevens synthesized a series of interactive videodisc design principles from the results of his study. (Copy available from University Microfilms, University of Michigan, Ann Arbor.)

A joint project of the Corporation for Public Broadcasting and The Annenberg School of Communications sponsored the University of Nebraska Videodisc Group to research, develop, and produce six videodisc lessons for use at the college level in introductory physics, biology and chemistry laboratory courses. The videodiscs were designed to enable students to perform science laboratory experiments via a personal computer interfaced with a videodisc player. The researchers found that the videodisc experiments could be successfully employed as alternatives to hands-on science laboratory instruction. Actual use of the system, including videodisc player, microcomputer and interface card, but not the color monitor, is available to secondary schools, colleges and universities on a 90-day, free-loan basis. A fee of U.S.$425 covers purchase of the videodiscs and computer software, and all administrative costs.

Two of the discs, Chemical Decision Making and Energy Tranformations, were used in a videodisc demonstration project in Bandung, Indonesia for the U.S. Agency for International Development. The project involved the design, production, testing, and now final evaluation of the two laboratory science videodiscs. The two discs were translated and revised to suit the technology, instructional level, and curricula of science education in Indonesia. The systems were set up in the chemistry and physics departments of the Institut Teknologi Bandung, and faculty members there were trained to conduct evaluations of students use and opinions regarding the lessons. The results of the evaluation are expected to be submitted to U.S.A.I.D. in April 1985. (ODR will receive a copy when the report is available.)

The World of Work, an integrated media package on the impact of new technologies on the job marketplace was delivered to the Center for Libraries and Education Improvement at the U.S. Department of Education in October 1984. The project, one of the few non-military videodisc projects commissioned by the U.S. government, includes a six-sided videodisc set, computer software, and print wraparound material. The six sides of The World of Work consist of two one-hour broadcast programs (segmented and chapter-stopped), titled "Is Technology Stealing Your Job?" and "Where Will You Work Tomorrow?", and a two-sided interactive disc on job-seeking skills with an extensive job database. The Department of Education hopes that the project will act as a catalyst, stimulating numerous job-retraining efforts. Government distribution plans for the discs have not yet been released.

The Architecture Machine Group (AMG) of the Massachusetts Institute of Technology has produced an interactive videodisc called Discursions that demonstrates the group's recent and ongoing research projects. The 16 chapters provide simultaneous access to a live video segment or a corresponding slide show, and contain the digitally-encoded text of published papers and theses.

Work at the AMG focuses on the exploration of new techniques for "natural human-computer interaction."[4] The contents of the chapters on the disc include the "Interactive Movie Map," a dynamic, interactive map that engages the viewer in a simulated drive through an unfamiliar space, using actual photographic imagery or computer-synthesized replicas of those images. The map reader may control the speed, route, angle of view, and mode of presentation. Another chapter on the disc contains "Communication News," a personal electronic

newspaper, that combines a remote access data search system (NEXIS) with a personal computer, local videodisc storage and full color display. The newspaper is edited and updated via the computer, which performs the search and display tasks, and can be controlled either by voice or touch. Discursions is available for U.S.$100. (A paper describing the project is available in ODR.)

EDUCATIONAL VIDEODISCS IN GREAT BRITAIN

An interactive videodisc was produced for the Open University by the Department of Physics at the University of Nebraska during 1983/84. The disc, called The Teddy Bear Disc, was based on an existing Open University television program and was supplemented by additional film, still, and graphic material. The program was designed for presentation at the end of an engineering course to illustrate how a number of topics taught contributed to the resolution of a civil court case centred around the fracture of plastic teddy bear eyes.

The disc required students to piece together evidence presented in court and concepts taught in the course to arrive at a judgment on the reasons for failure. Students were to interact via the keyboard of a microcomputer and, wherever practicable, to make written or numeric responses to questions rather that merely selecting an item from a multiple-choice menu. To further increase student involvement, they were asked to play the role of technical adviser to one of the barristers in the case.

While viewing the disc, the student proceeded through tutorials that incorporated video sequences overlayed with computer-generated text and graphics to illustrate the structure, behaviour and properties of plastics. These sequences were shot from the student's point of view, as if the student herself were performing tests and experiments with the materials. The student was able to control the pacing and sequence of the material, and to be tested on the terms and concepts presented when she felt ready.

The workstation was made available for students at a residential summer school to use at their convenience. All student responses via the keyboard were stored on the microcomputer's spare disc-drive unit and a student survey was carried out for two of the four weeks that the system was in use.

The project coordinators found that the disc's motivational story line interspersed with tutorials provided variation in pace and encouraged continual use. Further, they believed the use of video lent a reality to the exercises that is lacking in conventional CAI programs. An analysis of the computer-logged responses showed that in some areas, unclear

questions programmed in the computer elicited responses which were not anticipated and therefore not accommodated by the computer's repertoire of replies. This result supports the stipulation that the development of a teaching program be an interactive process with considerable student involvement.

A second generation program is currently in production to correct some of the original disc's problems. For example, the communication between elements within the system will be improved to give students control over such disc-playing functions as stop, forward, reverse, slow- or fast-motion, and jumping to the end of a particular sequence, allowing him or her to progress rapidly through the disc. In addition, a much-improved index will be made available to the student at any point in the disc to aid in locating his or her position within the package. The most important overall feature of the improved disc, according to the project leaders, is increased student control.

Another study at the Open University, conducted by Diane Laurillard, was designed to investigate how students would operate within a complex learning medium that gave them maximum control over the learning process. The study utilized a computer-controlled videocassette that was based on a carefully designed and evaluated learning package for a first year course in technology. The decision to use this videocassette was based on two criteria: more high-quality educational video is available on cassette than on disc, and technology is a subject area that lends itself well to the medium of computer-controlled video.

The aim of the study was to determine the appropriate balance between student control and program control with respect to the sequence of presentation of video segments, the number of practice level exercises to do, and alternating between modes of content presentation, i.e., viewing of video material (receptive), and doing computer-generated exercises (active). To test how students would deal with full control over the mode of presentation of material, two experimental groups were established. In one, the student was told that when viewing a video segment, he/she could stop it at any time and go on to something else, e.g., another video segment, exercises, etc. For the other group, the video was programmed to stop periodically and to offer the student options to continue with the selected segment, or to change to something else. The results show that students in the first group, who were left on their own to decide when to stop the video, would continue to watch it even after the

segment originally requested was completed and the disc had moved on to a different segment. Laurillard observed that this is inevitable with a medium that is designed to hold attention and to smooth the transition from one topic to another. Laurillard suggested that students watching the video have relinquished control over their learning strategy, and will only take control when directly offered the opportunity.

Another aspect of the study investigated how much students like to be advised on the sequence of content to be studied, and how much they like to make their own choice. One group of students was given no advice on the sequence of content. At each point where a choice had to be made whether to view a video segment or to do computer-generated exercises, the students were presented with the full video and computer indexes from which to choose. The students commented that they liked this freedom, but also would have liked advice. The second group was given advice on an appropriate sequence at each choice point. Students followed this advice 48% of the time; the rest of the time they made their own decision about the appropriate sequence. Laurillard concludes that students can make use of maximum control of their own learning, although they do like to have advice on what to do next.

The National Interactive Video Centre opened in London, England in October 1984. The Centre has been established by the Council for Educational Technology for the U.K., with financial support from the Department of Trade and Industry, the Manpower Services Commission, Philips, and Thorn EMI. The Centre will produce case studies, keep a register of current research, run seminars, and maintain an extensive workstation area where prospective users can gain direct hands-on experience on a full range of currently available hardware. The Centre is most interested in helping form links between the U.K. and other producers of interactive video.

EPIC Industrial Communication, a British video company, is conducting a project to compare the laser videodisc format with the video high density (VHD) format. The latter uses a stylus rather that a laser beam to read the information on the disc, has twice the linear playing time, is compatible with PAL, NTSC and SECAM video standards, can play both compact and videodiscs, and is smaller and less expensive.

The project involves the installation of videodisc players in 42 of Britain's Job Centres run by the Manpower Services Commission. Half of the centres will use Laservision (Philips) videodisc players, and the other half will use VHD players. The disc that has been developed for this project contains segments targeted at the long-term unemployed, handicapped and disabled workers, and people going into business for themselves. If the project is successful, the discs will be used at 1,000 job centres nationwide.

A full evaluation of system use will be completed by mid-1985. Initial observations have shown that the two systems are very popular, however the VHD discs wear out faster and lose both picture quality and control track information at a faster rate than laser discs (a number of VHD discs had to be replaced after six to eight weeks). The company has also learned that it is difficult but not impossible to design and implement identical programs for use with different hardware.

The Domesday project, a joint venture among Acorn Video, BBC, and Philips, will assemble the equivalent of two million pages of facts, figures, text, and maps, and over 85,000 photographs onto a computer-controlled videodisc. The project will mark the 900th anniversary in 1986 of the Domesday Book, William the Conqueror's sweeping survey of his new kingdom. (Information regarding the Domesday project is available in ODR.)

VIDEODISCS IN HEALTH EDUCATION

The capacity of videodiscs to simulate reality renders them useful to the medical and health professions. Videodiscs offer the opportunity to diagnose a patient's condition after viewing relevant test results, and then prescribe treatment and evaluate its effects. This technique is much safer, more practical, and more accessible than learning with actual patients. Videodiscs are also used for continuing professional education, to teach practicing physicians and nurses the nature and appearance of specific diseases, and their appropriate remedies. Other discs have been developed to train health professionals in patient interviewing and decision-making in medical education.

The Human Resources Research Organization in Virginia is developing a library of videodiscs on critical and emergency care. Each disc will have a patient care simulation in which the learner manages the patient, orders diagnostic and therapeutic measures, and sees the consequences of her decisions. The patient can be managed in a real-time mode or at the learner's own pace. Patient flow-sheets, wave tracings, X-rays, and lab data can be requested from the computer in a continually updated format. The first disc on critical and emergency care is complete, and 10 others are in different stages of design and production.

In 1981, the American Heart Association developed a computer-based interactive videodisc system for teaching cardiopulmonary resuscitation (CPR). The system teaches basic concepts and hands-on skills using two mannikins (one an adult, the other a child) equipped with special pressure sensors. When the student practices on the mannikins, the sensors send information to the computer to determine whether or not the student is properly administering CPR. The system can accommodate one to four people at a time, and no instructor is needed at any phase. The developers claim the interactive system meets or exceeds results of live instruction, and is responsive and easy to operate.

EDUCATIONAL VIDEODISCS FOR PUBLIC USE

Videodiscs are now being used to provide an entertaining, stimulating and useful source of consumer information. Point-of-purchase discs placed at department store sales counters describe the value and utility of products, while discs produced for Ford and General Motors use video images to show prospective buyers the available models and their standard and optional features. Travel agents are using videodiscs produced by airlines and tour wholesalers to describe vacation spots, hotels, and restaurants to their clients, and IBM has created a disc to train customers in the operation of their products.

Since 1974, the National Library of Canada has been experimenting with videodisc and optical disk for storing visual material and digital data. In 1976, a test videodisc was developed combining material from all the Library's visual media, including film, photographs, and paintings. The creation of this videodisc proved that videodisc can adequately store visual images from a combination of other media. More recently, archival data has been transferred from magnetic tape onto optical disk, a much less vulnerable medium. Optical disks allow a permanent, machine-readable record for statistics and other types of data accessible by computer. A pilot project is planned for this year to place archival records on optical disk. A spokesperson from the archive department estimated the system would be operational in two years.[5]

As part of its Optical Disk Pilot Program, launched in 1982, the Library of Congress in Washington, D.C. has undertaken to digitally store thousands of pages of printed materials on optical disks which will be made available to Library users for automatic retrieval, display, and printing of displayed material. Two compact audio disks of concerts held in the Library's Coolidge Auditorium will also be made. Nonprint materials, such as motion pictures, still photographs, cartoon and architectural drawings have been placed on videodiscs as substitutes for the actual items, which deteriorate from handling and use.

The pilot project will include evaluations of videodisc and optical disk use in several areas. The physical durability of the discs will be monitored over time. User information will be captured during terminal sessions, and user

acceptance of the system will be surveyed periodically. Experts at various operational levels of the Library will evaluate the organizational implications of using videodiscs, including their impact on collection development policies and cost/benefits.

At present, the Library's card catalogue is on optical disk. The disk stores, retrieves, and prints on demand 5.5 million catalog cards. The system, called DEMAND, has been in operation for five years and has made possible a reduction in cataloguing staff from 40 to six and virtually eliminated the number of lost, out of file, or misfiled cards. Unfortunately, the system has not been well-received by Library users. Library authorities are hoping that users will begin to perceive the videodisc as a more amenable technology.

The Metropolitan Museum of Art in New York has installed a videodisc in its new Michael C. Rockefeller Wing to provide visitors with background on the cultures that produced the primitive art shown. Four cultures--the Asmat of New Guinea, the Aztecs, the Indians of the Northwest Coast of the United States, and the People of Cameroon--can be studied via any of 23 subject areas at the user's request. Rare anthropological film and slide programs stored on the videodisc respond to requests for information.

Show Me St. Louis and Columbus at Your Fingertips are two interactive disc-based public information systems in Missouri and Ohio, respectively. Located at airports, shopping malls and other public sites, the discs provide advertising and information on shopping, dining, lodging, transportation, and related services. User demographics and response data are assembled and available to qualified advertising agencies free of charge.

Monty Hall is the host of the first Touch-n-Shop disc, installed in a multi-screen kiosk with a credit card reader to allow customers to place orders for discounted brand name merchandise to be shipped directly. Touch-n-shop is being test-marketed in supermarkets in Cleveland and California.

The capacity for videodiscs to provide high quality visual images makes them suitable for storing everything from rare visual artifacts to blood smears to a real-life "Let's Make a Deal." How and in what ways is this technology suitable for learning? Some videodisc developers have attempted to answer this question; many haven't thought to ask it.

ISSUES AND CONCERNS SURROUNDING THE USE OF VIDEODISCS IN EDUCATION

The issues section of Paper 13, "Educational Videodisc in Canada," detailed the problems of designing interactive learning, of assembling and training an appropriate design team, of the overemphasis on hardware and technology, and of the costs of development. Since the publication of that report, the cost of development, particularly for mastering and pressing discs, are decreasing. Experience has been gained in the design of interactive learning and videodiscs. But the core of these concerns--the secondary attention given to the process of learning and the needs of the learners--remains. This review has highlighted the rather sporadic and imcomplete research that is being conducted. Some of the individual studies offer valuable findings, but much development of videodiscs continues without reference to their implications.

Little attention has so far been paid to what actually happens when people interact with videodisc hardware and software. Future research might look into how the learning experience in a classroom setting compares to that of an independent, interactive learning station; whether independent learners feel isolated, frustrated or satisfied; and how much control do learners really have or want with an interactive, self-paced learning program. The responsibility of educators to the quality of learning makes it imperative that these types of questions be answered to effectively guide the development of educational videodiscs.

The evaluation of the Teddy Bear Disc at the Open University pointed to the need for students to have as much power and control as possible to manipulate the videodisc hardware and software. This can be facilitated, the study coordinators suggested, by allowing students to participate in the disc development process. Diane Laurillard's work showed that students' choice of learning sequence is not always what instructional developers would expect, and so it is important to make all options available to the learner, and to allow for variation in the use of stored data.

Scott Stevens' thesis at the University of Nebraska introduced some intriguing questions about the ways learners perceive material on the video screen. It would be important to compare Stevens' findings to those of studies that have

been done on television viewers' perceptions of reality on the television screen. How do video graphics, humor, music, and drama detract from or add to the learning experience? Are the visual characteristics of videodiscs too similar to those of television for learners to distinguish between them? Do learners use the same visual and critical skills (or lack thereof) for television viewing as they do for videodisc viewing? How do learning skills interact/relate/compare with viewing skills? If TVOntario were to be involved in videodisc development, this could be a particular area of interest and expertise for planning and evaluative research.

In a recent article in Instructional Innovator,[6] Marjorie Cambre argues that the focus of most research on interactive video is on hardware and systems concerns at the expense of inquiry into the processes of interactivity that lead to creative and effective outcomes. She describes three areas that need attention: the nature and effects of interactivity, instructional design of interactive materials, and formative research and evaluation of interactive products. New theories of learning, new instructional strategies, and new learning strategies are required to address new problems and potentials of picture-plus-computer interactivity.[7] Ms. Cambre calls for research and development to play a larger role in the design of interactive learning programs, and for funding agencies and publishers to support projects with an emphasis on process as well as product.

As an experienced and expert producer of video materials, learning systems, and software, TVOntario is likely to become involved in the development of videodiscs, either on our own initiative, or with a funding group. Any videodisc development at TVOntario should be well-informed by research throughout the process. The information from other developers and educators should be incorporated in all planning stages. One way of incorporating this research element would be the simultaneous design of a research project and the actual videodisc--so that the assumptions and choices that guided the videodisc development could be articulated and tested. This could provide insights into the principles of videodisc design that lead to most effective learning.

To use a well-worn phrase, videodisc technology goes beyond the sum of its parts. The combination of computer-assisted learning with video images creates a complex learning technology that involves the interplay of many variables.

When learners interact with this technology, the potential variations of interpretation and perception are compounded. Video and computer expertise are essental contributions to the understanding and development of educational videodiscs, but the major attention should be focused on the effects—positive and negative--achieved by the interaction of these two technologies.

NOTES

1. Kolyer, Diane. "Big Business is Branching Out into Disc." Videography, January 1984, pp.30-36.

2. Freire, Paulo. Pedagogy of the Oppressed, New York, Continuum, 1970.

3. Telephone conversation with Michelle Spak, ACCESS, March 1985.

4. Arons, Barry. "Discursions." Architectural Machine Group, Massachusetts Institute of Technology, 1984.

5. Telephone conversation with Ken Foster, National Archives, Ottawa, April 1985.

6. Cambre, Marjorie A. "Interactive Video." Instructional Innovator, September 1984, pp. 24-5.

7. Ibid.